REDACTED

WORK PLAN
BARITE HILL GOLD MINE

Prepared for
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (EPA)/
ENVIRONMENTAL RESPONSE TEAM (ERT)

Date:	March 16, 2007
Contract No:	EP-C-04-032
Assignment No.:	0-247

Approval:

REAC Task Leader _____ **Date:** 3/16/07

REAC Group Leader
(Cost Model Review) _____ **Date:** 3/16/07

REAC Program Manager _____ **Date:** 3/19/07

Lockheed Martin REAC
GSA Raritan Depot
2890 Woodbridge Avenue
BLDG 209 Annex
Edison, New Jersey 08837-3679

Work Assignment Number:	**0-247**
Work Assignment Title:	**Barite Hill Gold Mine**
Work Assignment Manager:	**Don Bussey**
Lockheed Martin REAC Task Leader:	**Jon McBurney**
Duration:	**February 2, 2007 thru December 31, 2008**
Contract No:	**EP-C-04-032**
Site ID:	**04ZZ**

INTRODUCTION

Purpose. The purpose of this work assignment (WA) is to provide technical support to the Environmental Protection Agency /Environmental Response Team (EPA/ERT) and EPA Region IV for the Barite Hill Gold Mine Site (Site). Specifically, Response Engineering and Analytical Contract (REAC) personnel will provide assistance for a Removal Site Evaluation (RSE) as per 40 CFR 300.410 of the mine and determine its impact on the surrounding areas.

Background. The Barite Hill Gold Mine is an inactive gold mine located about three miles south of McCormick, South Carolina (SC). The mine actively mined gold from 1991 to 1995. Between 1995 and 1999, the site was undergoing reclamation activities under the direction of Nevada Goldfields. In 1999, Nevada Goldfields filed for bankruptcy and the site was given to the South Carolina Division of Health and Environmental Control (SCDHEC).

The Site is located along a topographic high ridge area forming the headwaters of an unnamed tributary to Hawes Creek. The topography of the area consists of rolling hills with ridgelines at an elevation of approximately 510 feet. The permitted mine site totals 795.2 acres of which 659.7 acres are designated as buffer area. The facility used a cyanide solution in a heap leach process to extract gold from ore. Persuant to this method of extraction, there are three major waste rock piles contaminated with cyanide, seven processing ponds, several processing building with associated piping, and the large Main Pit from which the ore was mined. The Main Pit is now filled with pH 2 to 2.2 water with a high dissolved metal content. The surrounding rock contains a large amount of Barite ($BaSO_4$) and Pyrite (FeS_2). The weathering of the pyrite has depressed the pH of the Main Pit water. Seeps from the Main Pit containing the acidic water are impacting the unnamed tributaries of Hawes creek. Hawes Creek flows generally south and discharges into Strom Thurmond Lake.

In December of 2003, the SCDHEC performed a site investigation. The investigation found elevated levels of arsenic, cobalt, copper, cyanide, iron, lead, manganese, selenium and zinc in surface water, groundwater and soil samples. The EPA Region IV Emergency Response and Removal Branch (ERRB) On Scene Coordinator (OSC) has requested ERT assistance in completing a RSE regarding the impact to Hawes Creek and ultimately Strom Thurmond Lake under normal weather conditions and during catastrophic weather (hurricane, etc.) over a short term and longer term period.

General Assumptions. Assumptions concerning the scope of work, deliverable and task dates, and cost were made on the basis of existing knowledge of the project. New information and data, additional tasks and events outside REAC control will result in revisions to the approach and schedule proposed in this Work Plan (WP). Changes in project schedule, REAC project priorities, and resources available may also affect the specific details of this WP. The costs estimated to complete this project (including but not limited to labor, materials, analyses, and travel) were developed based on the current scope of work and may change as the project evolves.

If site conditions are not amenable, investigators, with the concurrence of the REAC Task Leader (TL) and Work Assignment Manager (WAM) will determine the appropriate mode of action in the field (e.g., altered methods, alternate locations). Any changes to the procedures outlined below will be recorded on a Work Assignment Field Change Form and signed by the WAM.

Site specific assumptions are as follows:

- The majority of the field work will be completed during the week of March 26, 2007. A second trip may be required to retrieve field data acquisition devices.
- The services of a landfill engineer will be procured to evaluate the existing condition and construction of onsite landfills.
- The number of REAC personnel required for this assignment is based on the availability of personnel from U.S. Fish and Wildlife (USFW) assisting in the completion of the Bioassessment portion of this WA.
- All analyses will be performed through the regional Contract Laboratory Program (CLP).
- REAC personnel will not enter, sample or contact the main pit water due to its highly acidic characteristics.

TECHNICAL APPROACH

The work necessary to complete this WA has been divided into the following tasks:

Task 1: Biological Assessment of Unnamed Tributaries to Hawes Creek. REAC personnel with the assistance of a representative from USFW Service will conduct a streamlined ecological assessment of impacted streams that border Site discharge areas to define the extent of the impact to the streams. The biological assessment will be based on the EPA Rapid Bioassessment Protocol I. The REAC team will walk the stream, beginning as far downstream of the outfall as possible. Using the EPA Protocol, personnel will visually inspect the stream life, record water quality measurements such as pH and conductivity, and take such samples of sedimentary areas as are deemed appropriate by ERT personnel or representatives at the time of the walkthrough. All sample locations will be recorded using a global positioning system (GPS) unit. Sediment samples will be submitted for Target Analyte List (TAL) metals analysis. REAC personnel will investigate other cyanide compounds that may be present in other forms and suggest alternate analyses as well as the toxicity or possible toxicity of the compounds. The team will also investigate other streams that may be impacted as well as areas upstream of the outfall for ambient stream conditions.

The deliverable from this investigation (to be included in the final report) will be a delineation of stream health and sediment composition, to include items such as contaminant concentrations and areas of probable deposition. All graphics will be presented in geographic information system (GIS) representations.

Task 2: Estimate the contaminant loading into the creek from the Main Pit during normal and catastrophic conditions.

To accomplish this task, REAC personnel will investigate the following items.

a. The water level fluctuations of the pit lake. A minitroll or other automatic water level recording device will be installed in the pit lake. The minitroll will be programmed to record the water level every ½ hour for a minimum of two months. The minitroll will be retrieved and downloaded to compare against regional precipitation events.

b. Determine the elevation difference between the top water level in the pit and the seep elevation. A relative survey will be completed to determine the difference in elevations of the seep and the pit water level to determine the hydraulic head acting on the seep.

c. Determine the influx of water to the pit. Based on the assumption agreed upon with Ed Bates of the EPA Office of Research and Development (ORD), the water influx would be simply the drainage basin area precipitation. A percentage may be added for miscellaneous influx of water other than precipitation, such as subsurface recharge to the pit. The precipitation will be based on historical research. REAC personnel will use the site activities as well as any available topographic maps to determine the drainage basin size.

d. Determine evaporative losses. Using historical data, an evaporative loss rate will be determined.

e. Determine the flowrate of the creek pre- and post- seep. The creek would be surveyed upstream of the seep and just downstream of the seep to determine the cross sectional area at each location. An average velocity measured at each location will allow the calculation of the flowrate. Based on the upstream flowrate and the downstream flowrate, the seep flowrate can be calculated.

f. Calculate the water balance. Given the influx, evaporative rate and water level changes, the flowrate of low pH water from the pit can be estimated. This flowrate, along with historical contamination levels in the pit will be used to determine the contaminant loading to the creek under normal circumstances. The seep flowrate will be used as a check against influx from springs in the pit or other sources of water.

g. To determine catastrophic impacts, the expected rainfall from a hurricane type event will be obtained and based on the pit lake surface area and drainage basin area, the approximate rise in pit lake elevation will be calculated. This result will be compared to the normal hydraulic head measured in Task 2b. The increased seep discharge and subsequent loading will be estimated as a ratio of hydraulic head differences. The other possibility for catastrophic release would be overtopping the pit wall next to the stream. The calculated pit lake water elevation and the elevation of surrounding features will determine if this is a possible failure mode.

Task 3: Lagoon and process equipment sampling.

To investigate the lagoons, REAC personnel will perform a six-point composite sample of the sediments in each lagoon. An estimation of the depth to sediment will also be taken in several places in each lagoon. The construction details of each lagoon will be researched to assist in evaluating the design depth of each lagoon. REAC personnel will utilize a John boat to investigate the lagoons. The available freeboard of each lagoon will be identified to determine the possibility of overflow during precipitation events. Any likely paths of discharge will be identified.

Based on discussions with a SCDHEC representative, the following items will need to be investigated during the field activities:

a. 500 Gallon Above Ground Storage Tank (AST). This tank has not been opened, but is believed to have been a cyanide solution holding tank. It is also believed that approximately 10 to 15 gallons of fluid remain in the tank. This tank will require sampling and hazardous waste categorization (HAZCAT).

b. 75 Gallon Plastic AST. This tank currently contains an unknown amount of white powder. Several of the chemicals used in the leaching process can be described as white powder. This material will require sampling and HAZCAT.

c. Bags of Chemicals have been reported in the process buildings. These will require identification and investigation. REAC personnel will attempt to identify the contents of each bag and record the markings. Waste may require sampling and HAZCAT.

d. Piping. Various runs of piping have been observed both above ground and underground. These piping sections will require investigation and possible sampling and HAZCAT.

e. Sump in Ingot Room. In the room designated as the ingot room, there is a sump of unknown depth/construction. It was observed by the SCDHEC personnel that the room has been observed several times with a depth of 2 to 3 inches of water. This water will be investigated, sampled and analyzed.

f. Drums. Based on a discussion with the SCDHEC person familiar with the site, there was only one drum observed floating in the Main Pit. This WP does not cover the sampling, investigation nor recovery of this drum. Should another drum be found on site away from the Main Pit, it will require investigation, possible sampling and possible HAZCAT.

Task 4: Conduct a geotechnical evaluation of cyanide heap leach piles and evaluate stability of the existing caps.

Per discussion with the ERT WAM, this task will be handled by Bureau of Reclamations (BofR) personnel. The BofR will provide qualified field personnel to accomplish this task and will generate a stand alone report for the EPA. The BofR work plan has been attached as attachment 1.

Task 5: Sample Analysis. All samples will be sent to an EPA Region IV CLP laboratory for TAL Metals, total cyanide analyses. The Region IV OSC will coordinate sample analyses with the Region IV CLP Coordinator.

Task 6. Lagoon Sediment Analysis. All lagoon sediments will be submitted to the Region IV CLP lab for total and WAD cyanide analyses as well as TAL Metals analyses.

Quality Assurance Project Plan. Project management, measurement, assessment and usability elements applicable to this WA are included in the corresponding site-specific Quality Assurance Project Plan (QAPP).

Standard Operating Procedures. The Standard Operating Procedures (SOPs) and Administrative Procedures (APs) relevant to this WA are included in the project-specific QAPP. REAC personnel will adhere to the following health and safety SOPs for this WA:

- SOP #3001, *REAC Health and Safety Program Policy and Implementation*
- SOP #3012, *REAC Health and Safety Guidelines for Activities at Hazardous Waste Sites*
- SOP #3020, *Inclement Weather, Heat Stress and Cold Stress*

STAFFING PLAN AND SCHEDULE

Staffing Plan. The REAC TL will maintain contact with the WAM to provide information on the technical and financial progress of the project. This communication will commence with the issuance of the WA. Activities will be summarized in appropriate format for inclusion in REAC Monthly Reports.

The original WA for this project was received on February 2, 2007. The WP was initiated within 30 days of receiving the WA. The project will be completed by December 2008.

The REAC TL/Quality Control (QC) Coordinator is the primary REAC point of contact with the WAM. The TL is responsible for the development and completion of the WP and QAPP, project team organization, and supervision of all project tasks, including reports and deliverables. In addition, the TL is responsible for ensuring adherence to, and recording any deviations from the WP or QAPP.

The REAC Quality Assurance Officer (QAO), Health and Safety Officer, Air Section Leader and Operations Section Leader are responsible for auditing and guiding the project team, reviewing/auditing the deliverables and proposing corrective action, if necessary, for nonconformity to the WP and QAPP.

This project will require a variety of skills and personnel, including toxicologists, field sampling technicians and technical support. The following REAC personnel will work on this project:

Personnel	Responsibilities	Level of Responsibility
Environmental Engineer	TL, Field Sampling, Report Preparations	P3
Phytoremediation Biologist	Bioassessment Survey	P3
Geologist	Field Sampling, Surveying, Troll Installation	P3
Environmental Engineer	Field Sampling, Surveying, Field Assistance	P2
Air Scientist	HAZCAT, Air monitoring, Field Sampling	P3
Engineering Group Leader	Document Review/Engineering input	P4
Operations Section Leader	Document Review	P4
Hydrogeologist	Pit Water Balance, Hydrogeology	P4
QAO	WP and QAPP Review	P4
Environmental Technician	Sample Coordination, GPS, Bioassessment Survey	T2
Administrative Support	Document Archival	T3
GIS Technician	Maps and Figures	P2

Additional REAC technical and/or administrative personnel and subcontractors may work on this project as needed.

Schedule of Activities. The anticipated schedule of activities is as follows:

WP	March 16, 2007
QAPP	March 23, 2007
Site Health and Safety Plan	March 10, 2007
Field Activities	Week of March 26, 2007
Final Report	Within 30 days of final data packages from laboratories and subcontract engineer.

All project deliverable and task dates are estimates based on the information available at the time of WP completion. New information, additional tasks and events outside REAC control may result in revisions to these dates.

Training and Conference/Meeting/Seminar Attendance. In the course of performing the above tasks, REAC personnel may attend training offered by the EPA such as safety training, training for procedural changes made by the EPA, or training offered by outside vendors of specific equipment or instrumentation. Specific training instruction will be authorized in advance by the Project Officer and approved by the Contracting Officer. As authorized by the Project Officer and approved by the Contracting Officer, REAC personnel may attend a technical conference, meeting, or seminar to perform or support WA activities. For the ERT to successfully fulfill their mission to share and disseminate scientific information, REAC personnel will provide technical support to prepare (and present as necessary) technical papers/posters at scientific meetings or conferences.

LEVEL OF EFFORT AND COST PROJECTION

The estimated costs to complete this project are depicted in the attached cost summary sheet. The estimated costs are based on the hours allotted by the WA and costs associated with similar projects. Activities such as electronic technical data documentation, photo documentation, computer graphics and support, statistics, report preparation, and purchasing support may also be required to accomplish project objectives. Labor hours for these activities have been included in the cost estimate.

Travel Assumptions are as follows:

Trip	Personnel	Duration (Days)
1	6	5
2	2	2

Vendor Services. Vendor services may include, but are not limited to rental equipment and other services related to work outlined in this WP.

References

SCDHEC 2004. Site Investigation. Barite Hill/Nevada Goldfields. SCD 987 597 903. Columbia, SC. 1-27

United States Department of the Interior. Clark, Sandra. *Geologic Maps and Block Diagrams of the Barite Hill Gold-Silver Deposit and Vicinity, South Carolina and Georgia.* U.S. Geological Survey, National Center, MS 954, Reston, VA 22092, 1-5

Attachment 1.

Environmental Services for the Barite Hill Mine, South Carolina

Introduction

The Barite Hill mine is located 3 miles south of McCormick, South Carolina. It was operated as a surface mine with cyanide heap-leaching for gold recovery from 1991 until 1995 when mine reclamation was initiated. The company, Nevada Goldfields, suspended site reclamation when they entered into bankruptcy in 1999. The gold ore at the mine contains significant amounts of pyrite which is a source of acid rock drainage. The Environmental Protection Agency (EPA) is currently evaluating the property for a potential removal action. The Bureau of Reclamation (Reclamation) has considerable experience in the planning, design, and construction management of mine reclamation and closure projects. Reclamation proposed to complete the following scope of work in support of EPA activities at Barite Hill.

Scope of Work

Reclamation will prepare a site environmental inventory for the Barite Hill mine in McCormick, South Carolina. The purpose of the inventory is gather factual information about the site features, gather and assemble relevant records, and identify various environmental issues in support of further mine reclamation and closure activities. The work includes the following tasks:

1. **Site visit**

Reclamation personnel will travel to the site to gather relevant documents and drawings, and conduct a two-day intensive inventory of site features and infrastructure. It is assumed that water and materials sampling and analysis will be performed by others and is not included. A two person team is envisioned to review, photograph, and make preliminary measurements and notes about the condition of the following aspects of the mine if present:

a. Mine pits and waste rock piles, silos, crushing, screening, and conveying facilities.
b. **Heap-leach pads and ore stockpiles**
c. **Process ponds and related process water handling facilities including pipelines, pump stations, process equipment, tanks, and sumps.**
d. **Buildings, bone yards, chemicals, access roads, access gates, fencing, power lines and transformers, septic systems, water supply and fire suppression systems.**
e. **Topsoil and other material stockpiles.**
f. **Surface water bodies, clean water diversions and ditches, contaminated water diversions and capture facilities.**

g. **Groundwater wells, French drains, seeps, and other features related to groundwater.**

2. **Document Review**

Reclamation will review site documentation provided by EPA and gathered during the site visit to identify important information about the mine site. Reference maps, drawings, and data tabulations will be copied for inclusion in the inventory report.

3. **Report Preparation**

The results of the site inventory will be summarized in the inventory report. All significant site features will be described as to size and condition and documented with captioned photographs. Environmental issues associated with each feature will be described along with reference to relevant sample analysis data if available. The report will include an executive summary about the site and its environmental issues. Site features and issues will be summarized in table format to provide a quick overview. Recommendations regarding initial findings about the site will be included.

4. **Client Coordination**

Due to the preliminary nature of the proposed work, it is envisioned that there will be several coordination conferences with the client both prior to the site visit and after submission of the draft report. A total of 2 days additional staff time has been estimated as needed for communication with the EPA.

Project Funding

Reclamation estimates [redacted] will be required to complete the scope of work described in this proposal.

Project Schedule

The following schedule is proposed:

Schedule Item	Time Required
Initial Site Visit	Within 30 days of funding authorization.
Draft Report	30 days after site visit
Final Report	10 days after comments are received